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$x_{\text{H}_2\text{Oexp}}$ = maximum expected mole fraction of water during emission testing, according to paragraph (b) of this section.

$x_{\text{H}_2\text{Omeas}}$ = measured mole fraction of water during the quench verification, according to § 1065.370(e)(7).

x_{NOmeas} = measured concentration of NO when NO span gas is blended with CO₂ span gas, according to § 1065.370(d)(10).

x_{NOact} = actual concentration of NO when NO span gas is blended with CO₂ span gas, according to § 1065.370(d)(11) and calculated according to Equation 1065.675-2.

$x_{\text{CO}_2\text{exp}}$ = maximum expected concentration of CO₂ during emission testing, according to paragraph (c) of this section.

$x_{\text{CO}_2\text{act}}$ = actual concentration of CO₂ when NO span gas is blended with CO₂ span gas, according to § 1065.370(d)(9).

$$x_{\text{NOact}} = \left(1 - \frac{x_{\text{CO}_2\text{act}}}{x_{\text{CO}_2\text{span}}} \right) \cdot x_{\text{NOspan}}$$

Eq. 1065.675-2

Where:

x_{NOspan} = the NO span gas concentration input to the gas divider, according to § 1065.370(d)(5).

$x_{\text{CO}_2\text{span}}$ = the CO₂ span gas concentration input to the gas divider, according to § 1065.370(d)(4).

Example:

$x_{\text{NOdry}} = 1800.0 \text{ } \mu\text{mol/mol}$
 $x_{\text{NOWet}} = 1739.6 \text{ } \mu\text{mol/mol}$
 $x_{\text{H}_2\text{Oexp}} = 0.030 \text{ mol/mol}$
 $x_{\text{H}_2\text{Omeas}} = 0.030 \text{ mol/mol}$
 $x_{\text{NOmeas}} = 1515.2 \text{ } \mu\text{mol/mol}$
 $x_{\text{NOspan}} = 3001.6 \text{ } \mu\text{mol/mol}$
 $x_{\text{CO}_2\text{exp}} = 3.2\%$
 $x_{\text{CO}_2\text{span}} = 6.1\%$
 $x_{\text{CO}_2\text{act}} = 2.98\%$

$$x_{\text{NOact}} = \left(1 - \frac{2.98}{6.1} \right) \cdot 3001.6 = 1535.24459 \text{ } \mu\text{mol/mol}$$

$$\text{quench} = \left(\left(\frac{1739.6}{1 - 0.030} - 1 \right) \cdot \frac{0.030}{0.030} + \left(\frac{1515.2}{1535.24459} - 1 \right) \cdot \frac{3.2}{2.98} \right) \cdot 100 \%$$

$$\text{quench} = (-0.0036655 - 0.014020171) \cdot 100\% = -1.7685671\%$$

[73 FR 59340, Oct. 8, 2008, as amended at 76 FR 57466, Sept. 15, 2011]

§ 1065.690 Buoyancy correction for PM sample media.

(a) *General.* Correct PM sample media for their buoyancy in air if you weigh them on a balance. The buoyancy correction depends on the sample media density, the density of air, and the density of the calibration weight used to calibrate the balance. The buoyancy

correction does not account for the buoyancy of the PM itself, because the mass of PM typically accounts for only (0.01 to 0.10)% of the total weight. A correction to this small fraction of mass would be at the most 0.010%.

(b) *PM sample media density.* Different PM sample media have different densities. Use the known density of your sample media, or use one of the densities for some common sampling media, as follows:

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(1) For PTFE-coated borosilicate glass, use a sample media density of 2300 kg/m³.

(2) For PTFE membrane (film) media with an integral support ring of polymethylpentene that accounts for 95% of the media mass, use a sample media density of 920 kg/m³.

(3) For PTFE membrane (film) media with an integral support ring of PTFE, use a sample media density of 2144 kg/m³.

(c) *Air density.* Because a PM balance environment must be tightly controlled to an ambient temperature of (22 ±1) °C and humidity has an insignificant effect on buoyancy correction, air

density is primarily a function of atmospheric pressure. Therefore you may use nominal constant values for temperature and humidity in the buoyancy correction equation in Eq. 1065.690-2.

(d) *Calibration weight density.* Use the stated density of the material of your metal calibration weight. The example calculation in this section uses a density of 8000 kg/m³, but you should know the density of your weight from the calibration weight supplier or the balance manufacturer if it is an internal weight.

(e) *Correction calculation.* Correct the PM sample media for buoyancy using the following equations:

$$m_{\text{cor}} = m_{\text{uncor}} \cdot \frac{1 - \frac{\rho_{\text{air}}}{\rho_{\text{weight}}}}{1 - \frac{\rho_{\text{air}}}{\rho_{\text{media}}}} \quad \text{Eq. 1065.690-1}$$

Where:

m_{cor} = PM mass corrected for buoyancy.

m_{uncor} = PM mass uncorrected for buoyancy.

ρ_{air} = density of air in balance environment.

ρ_{weight} = density of calibration weight used to span balance.

ρ_{media} = density of PM sample media, such as a filter.

$$\rho_{\text{air}} = \frac{p_{\text{abs}} \cdot M_{\text{mix}}}{R \cdot T_{\text{amb}}} \quad \text{Eq. 1065.690-2}$$

Where:

p_{abs} = absolute pressure in balance environment.

M_{mix} = molar mass of air in balance environment.

R = molar gas constant.

T_{amb} = absolute ambient temperature of balance environment.

Example:

$p_{\text{abs}} = 99.980 \text{ kPa}$

$T_{\text{sat}} = T_{\text{dew}} = 9.5 \text{ °C}$

Using Eq. 1065.645-1,

$p_{\text{H}_2\text{O}} = 1.1866 \text{ kPa}$

Using Eq. 1065.645-3,

$x_{\text{H}_2\text{O}} = 0.011868 \text{ mol/mol}$

Using Eq. 1065.640-9,

$M_{\text{mix}} = 28.83563 \text{ g/mol}$

$R = 8.314472 \text{ J/(mol·K)}$

$T_{\text{amb}} = 20 \text{ °C}$

$$\rho_{\text{air}} = \frac{99.980 \cdot 28.83563}{8.314472 \cdot 293.15}$$

$\rho_{\text{air}} = 1.18282 \text{ kg/m}^3$

$m_{\text{uncor}} = 100.0000 \text{ mg}$

$\rho_{\text{weight}} = 8000 \text{ kg/m}^3$

$\rho_{\text{media}} = 920 \text{ kg/m}^3$

$$m_{\text{cor}} = 100.0000 \cdot \left[\frac{1 - \frac{1.18282}{8000}}{1 - \frac{1.18282}{920}} \right]$$

$m_{\text{cor}} = 100.1139 \text{ mg}$

[70 FR 40516, July 13, 2005, as amended at 73 FR 37339, June 30, 2008; 75 FR 23056, Apr. 30, 2010]

§ 1065.695 Data requirements.

(a) To determine the information we require from engine tests, refer to the standard-setting part and request from your Designated Compliance Officer the format used to apply for certification or demonstrate compliance. We may require different information for different purposes, such as for certification applications, approval requests for alternate procedures, selective enforcement audits, laboratory audits, production-line test reports, and field-test reports.

(b) See the standard-setting part and § 1065.25 regarding recordkeeping.

(c) We may ask you the following about your testing, and we may ask you for other information as allowed under the Act:

(1) What approved alternate procedures did you use? For example:

- (i) Partial-flow dilution for proportional PM.
- (ii) CARB test procedures.
- (iii) ISO test procedures.

(2) What laboratory equipment did you use? For example, the make, model, and description of the following:

- (i) Engine dynamometer and operator demand.
 - (ii) Probes, dilution, transfer lines, and sample preconditioning components.
 - (iii) Batch storage media (such as the bag material or PM filter material).
- (3) What measurement instruments did you use? For example, the make, model, and description of the following:
- (i) Speed and torque instruments.
 - (ii) Flow meters.
 - (iii) Gas analyzers.
 - (iv) PM balance.

(4) When did you conduct calibrations and performance checks and what were the results? For example, the dates and results of the following:

- (i) Linearity checks.
 - (ii) Interference checks.
 - (iii) Response checks.
 - (iv) Leak checks.
 - (v) Flow meter checks.
- (5) What engine did you test? For example, the following:

- (i) Manufacturer.
 - (ii) Family name on engine label.
 - (iii) Model.
 - (iv) Model year.
 - (v) Identification number.
- (6) How did you prepare and configure your engine for testing? Consider the following examples:

- (i) Dates, hours, duty cycle and fuel used for service accumulation.
- (ii) Dates and description of scheduled and unscheduled maintenance.
- (iii) Allowable pressure range of intake restriction.
- (iv) Allowable pressure range of exhaust restriction.
- (v) Charge air cooler volume.
- (vi) Charge air cooler outlet temperature, specified engine conditions and location of temperature measurement.
- (vii) Fuel temperature and location of measurement.
- (viii) Any aftertreatment system configuration and description.
- (ix) Any crankcase ventilation configuration and description (e.g., open, closed, PCV, crankcase scavenged).

(7) How did you test your engine? For example:

- (i) Constant speed or variable speed.
- (ii) Mapping procedure (step or sweep).
- (iii) Continuous or batch sampling for each emission.
- (iv) Raw or dilute sampling; any dilution-air background sampling.
- (v) Duty cycle and test intervals.
- (vi) Cold-start, hot-start, warmed-up running.